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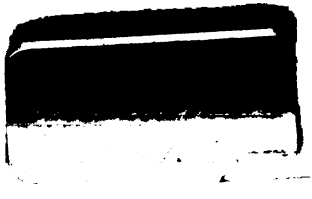

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REPORT

OF THE

NATIONAL ACADEMY OF SCIENCES

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FOR
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THE YEAR 1886.

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49TH CONGRESS, 2d Session. } SENATE. { MIS. DOC. 30, Part 1.

REPORT

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LETTER OF TRANSMITTAL.

NATIONAL ACADEMY OF SCIENCES,
Washington, D. C., January 10, 1887.

SIR: In conformity with the requirements of the act of incorporation, approved March 3, 1863, I have the honor to submit herewith a report of the operations of the National Academy of Sciences during the past year.

Very respectfully,

O. C. MARSH,
President of the National Academy of Sciences.

The PRESIDENT OF THE SENATE.

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REPORT

OF

THE NATIONAL ACADEMY OF SCIENCES.

The National Academy of Sciences was established by act of Congress, in March, 1863, with power to frame its own constitution, select its own members, and provide in other respects for its continuance and successful operation.

The object of the Academy is to advance science, and especially to investigate, examine, experiment, and report on any subject of science or art, whenever called upon by any Department of the Government.

The Academy contains at present about one hundred members, and these have all been selected for their original researches in science. They represent within their ranks nearly every department of knowledge, and their services, in accordance with the charter of the Academy, are always at the disposal of the Government, without compensation.

SESSIONS OF THE NATIONAL ACADEMY.

During the past year, the Academy has held three sessions. The first was the regular annual meeting, held in Washington, D. C., April 20 to 23, 1886; the second was a scientific session, in Boston, Mass., November 9 to 11, 1886; and the third was a special session, in Boston, Mass., November 10, 1886.

STATED SESSION.

HELD IN WASHINGTON CITY, APRIL 20 TO 23, 1886.

The Washington session was held in the National Museum, the president, Prof. O. C. Marsh, presiding.

The following members were present during the session:

Abbe.	Gilbert.	Meigs.	Remsen.
Baird.	Gill.	Mitchell, H.	Rood.
Barker.	Hague.	Mitchell, S. W.	Rowland.
Bell.	Hall, A.	Morse.	Schott.
Billings.	Hilgard, J. E.	Newcomb.	Scudder.
Brooks.	Hill, G. W.	Newton, H. A.	Sellers.
Coffin.	Hunt.	Packard.	Smith.
Cope.	Langley.	Powell.	Wright.
Dutton.	Marsh.	Pumpelly.	Young.
Ferrel.	Mayer.		

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The president gave a short account of the business of the Academy during the past year, referring particularly to requests from the Government for investigations, to the subject of the publications of the Academy, and to the report of the committee on the Draper medal.

At this session, the following papers were read:

1. GILBERT, G. K.—The Geologic Age of the Equus Fauna. Discussed by Messrs. Cope, Powell, Gilbert, Marsh, and Gill.
2. COPE, E. D.—On the Phylogeny of the Batrachia. Discussed by Messrs. Gill, Morse, Marsh, and Cope.
3. HUNT, T. STERRY.—The Cowles Electrical Furnace. Remarks by Mr. Sellers.
4. COPE, E. D.—On the Phylogeny of the Placental Mammalia. (Read by title.)
5. NEWTON, H. A.—The Comet of Biela. Discussed by Messrs. Hall, Young, Newton, and Marsh.
6. LANGLEY, S. P.—On the Invisible Spectra. Discussed by Messrs. Gill, Rowland, Brooks, Newcomb, Langley, Dutton, Smith, and Scudder.
7. SCUDDER, S. H.—The Cockroach in the Past and in the Present. Remarks by Mr. Gill.
8. MAYER, ALFRED M.—On the Diathermancy of Ebonite and Obsidian, and on the Production of Calorescence by means of Screens of Ebonite and Obsidian. Discussed by Messrs. Langley, Bell, Mayer, Rowland, and Barker.
9. MAYER, ALFRED M.—On the Coefficient of Expansion of Ebonite.
10. MAYER, ALFRED M.—On the Determination of the Cubical Expansion of a Solid by a Method which does not require Calibration of Vessels, Weighings, or Linear Measure.
11. MAYER, ALFRED M.—On Measures of Absolute Radiation. Discussed by Messrs. Rowland, Mayer, Rood, and Young.
12. MORSE, EDWARD S.—On Ancient and Modern Methods of Arrow Release.
13. LOOMIS, ELIAS.—Areas of High Barometric Pressure over Europe and Asia. (Read by Mr. Ferrell.)
14. COPE, E. D.—On the Geology of the Region near Zacualtipan, Hidalgo, Mexico.
15. GILL, THEODORE.—The Ordinal and Superordinal Groups of Fishes. Discussed by Messrs. Cope and Gill.
16. ROWLAND, H. A.—On the Absolute and Relative Wave-Lengths of the Lines of the Solar Spectrum. Discussed by Messrs. Langley and Rowland.
17. GIBBS, WOLCOTT.—Platinous Compounds as Additive Molecules. (Read by Mr. Remsen.)
18. BECKER, G. F. (by invitation of the Academy).—Cretaceous Metamorphic Rocks of California.
19. BROOKS, W. K.—The Stomatopoda of the "Challenger" Collection.
20. REMSEN, IRA.—Influence of Magnetism on Chemical Action. Discussed by Messrs. Mayer, Wright, Remsen, Bell, and Rood.
21. WRIGHT, A. W.—Crystallization of Platinum by means of the Electric Discharge in Vacuo. Discussed by Messrs. Mayer, Wright, and Remsen.
22. BELL, A. GRAHAM.—Upon the Deaf and Dumb of Martha's Vineyard (continuation of research relating to the ancestry of the deaf). Discussed by Messrs. Gilbert, Brooks, Bell, and Gill.
23. ROOD, OGDEN N.—On Color Contrast.
24. PEIRCE, C. S.—Review of Paper on Color Contrast. (Read by Mr. Gill.)
25. WALCOTT, CHARLES D. (by invitation of the Academy).—Classification of the Cambrian System of North America. Discussed by Messrs. Hunt and Walcott.
26. BROOKS, W. K.—Budding in the Tunicata. (Read by title.)
27. WRIGHT, A. W.—Effect of Magnetism on the Electrical Resistance of Metals. (Read by title.)
28. PEARY, R. E. (by invitation of the Academy).—On a Proposed Expedition into the Interior of Greenland during the present Summer, with Disco as a Base.

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BIOGRAPHICAL MEMOIRS.

The following biographical notices were read:

Of Dr. Arnold Guyot, by Prof. James D. Dana. (Read by Mr. Young.)

Of Prof. John W. Draper, by Prof. George F. Barker.

ELECTIONS.

Mr. Wolcott Gibbs was elected foreign secretary in place of Mr. Agassiz, whose term of office expired with this session, and who, on account of ill health, declined a re-election.

The following members were selected for the council for the ensuing year: Messrs. S. F. Baird, G. J. Brush, S. P. Langley, M. C. Meigs, E. C. Pickering, and C. A. Young.

HOME SECRETARY'S REPORT.

The home secretary submitted the following report:

APRIL 20, 1886.

The following publications of the Academy have been distributed during the past year:

(1) Part I of the third volume of the Memoirs.

(2) The president's Annual Report for the years 1883 and 1884.

(3) The second part of the first volume of the Proceedings.

The distribution of our publications has brought in return a large number of Memoirs from various parts of the world. Generally, these are incomplete sets or single volumes. Some of them are valuable. Many requests have been made for our first volume of Memoirs. In reply to a few of the more urgent requests, this volume has been sent. We have about three hundred copies on hand.

There has been considerable demand for the Annual Reports of 1883 and 1884, from professors and students, and copies have been sent to all who have asked for them.

TREASURER'S REPORT.

The treasurer presented the following report, which had been examined by the auditing committee, Messrs. Newton, Scudder, and Hague, and approved:

1. *General account, April* 21, 1885, *to April* 19, 1886.

RECEIPTS.

Cash balance from last year	$166 06
Dues collected from members	465 00
Interest on $500 District of Columbia 3.65 bond	18 25
Expenses of committee on surveys, refunded	239 90
Expenses of committee on Observatory, refunded	81 75
Expenses of committee on wool, refunded	145 89
Total receipts	1,116 85

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EXPENDITURES.

Printing	$69 35	
Assistant to home secretary	57 00	
Expenses of home secretary and treasurer	33 46	
Expenses of April meeting	100 00	
Expenses of Observatory Committee	81 75	
Expenses of wool committee	145 89	
Total expenditures		$487 45
Cash balance on hand April 19, 1886		629 40
Dues from members		85 00
$500 District of Columbia 3.65 bond, market value		595 00
Total assets		1,309 40

2. *The Bache Trust Fund.*

RECEIPTS.

Cash balance from last year	$2,099 92
Interest on securities	2,272 23
Sale of $3,000 District of Columbia 3.65 bonds	3,474 75
Refunded by Professor Holden	20 26
Total receipts	7,867 16

EXPENDITURES.

Tax on Missouri lands	$4 00	
Professor Michelson, investigations on the velocity of light	283 97	
Professor Pickering, investigations on stellar photography	2,000 00	
Professor Hilgard, magnetic work	200 00	
Yale College Observatory, on mass of Saturn	600 00	
New England Meteorological Society, investigations on thunder storms	300 00	
Webster, investigations on mechanical equivalent of heat	250 00	
Total expenditures		$3,637 97
Cash balance on hand April 19, 1886		4,229 19
$1,500 District of Columbia 3.65 bonds, market value		1,785 00
Total assets		6,014 19
Outstanding orders		4,500 00
Excess of assets		1,514 19

3. *The Watson Trust Fund.*

RECEIPTS.

Cash balance from last year	$900 00
Interest on securities	782 00
Total receipts	1,682 00

EXPENDITURES.

Work on asteroids	$202 50	
Blank book	75	
Dies for Watson medal	300 00	
Total expenditures		503 25
Cash balance on hand April 19, 1886		1,178 75

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4. *The Henry Draper Medal Fund.*

RECEIPTS.

Cash balance from last year	$400 00
Interest on securities	200 00
Total receipts	600 00

EXPENDITURES.

Draft on Paris for medal	203 90
Cash balance on hand April 19, 1886	396 10

5. *The J. Lawrence Smith Medal Fund.*

RECEIPTS.

Cash from last year	$170 00
Interest received on securities	324 00
Total receipts	494 00

J. H. C. COFFIN,
Treasurer.

The following report of the committee to examine securities held by the Academy was read and approved:

WASHINGTON, D. C., *April* 21, 1886.

The committee, Messrs. Billings and Dutton, appointed to examine the securities in the hands of the treasurer, report that they have examined the said securities, and find that they are as follows:

1. *General Fund.*

District of Columbia 3.65 bonds	$500 00

2. *Bache Trust Fund.*

United States loan, 4½ per cent	$42,100 00
United States loan, 4 per cent	3,850 00
City of Davenport loan, 6 per cent	1,000 00
City of Philadelphia loan, 6 per cent	600 00
	47,550 00

Also, a deed of 160 acres of Missouri lands not yet recorded in the name of the Academy, and four medals presented to the late A. D. Bache, and received from his estate.

3. *Invested income of the Bache Fund.*

District of Columbia 3.65 per cent	$1,500 00

4. *Joseph Henry Fund.*

An agreement with the Pennsylvania company for insurance on lives and granting annuities, as to the final disposition of the Joseph Henry fund of	$40,000 00

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5. *Watson Trust Fund.*

United States loan, 4½ per cent	$6,200 00
United States loan, 4 per cent	850 00
Certificates for 134 shares of capital stock of the Michigan Life Insurance Company	6,700 00
	13,750 00

6. *Henry Draper Medal Fund.*

United States loan, 4 per cent	$5,000 00

Also, a deed of trust of Mary Anna Palmer Draper to the National Academy of Sciences.

7. *J. Lawrence Smith Medal Fund.*

United States loan, 4½ per cent	$7,200 00

Also, a deed of trust of Sarah Julia Smith to the National Academy of Sciences.

DEATH OF MEMBERS.

The president announced the death, on March 15, 1886, of Dr. Edward Tuckerman, of Amherst, Mass.

Mr. G. W. Farlow was appointed to prepare a biographical notice.

RESOLUTIONS.

Upon recommendation of the council, the Academy adopted the following resolutions:

Resolved, That the assessment for the ensuing year be $5.

Resolved, That the gold and other medals presented to the late A. D. Bache, and now in the hands of the treasurer of the Academy, be deposited in the National Museum, subject to the order of the Academy.

Resolved, That the treasurer be authorized to defray, when approved by the president, all the proper expenses of committees appointed to make scientific investigations at the request of Departments of the Government, and in each case to look to the Department requesting the investigation for reimbursement to the Academy.

CONSTITUTIONAL AMENDMENT.

The Academy, in committee of the whole, adopted the following amendment to the constitution, which will be voted on at the next stated session:

In Article V, section 6: Strike out the words "and before its presentation, submitted by him, first to the council, and afterwards to the Academy at one of the stated sessions."

REPORTS OF COMMITTEES.

The president appointed Mr. S. Weir Mitchell a member of the committee on ways and means in place of Mr. Agassiz, who was unable to serve on account of ill health; and, in the absence of the chairman, reported that nothing important had been done.

In the absence of the chairman of the committee on weights, measures, and coinage, Mr. Meigs reported that no meeting of the committee had recently been called.

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Mr. Agassiz, the chairman of the committee on the election of foreign associates, being absent, statements were made by the president and Mr. Newcomb, and the committee was continued, to report at the next meeting of the Academy.

Mr. Langley, the chairman of the committee on reserving public lands on and near Mount Whitney, California, for scientific purposes, stated that matters were in much the same condition as at the last meeting, and that he had nothing special to report.

Mr. S. Weir Mitchell, the chairman of the committee to co-operate with the National Board of Health, reported that it had been four years since the Board of Health had called upon the committee for assistance; and on his motion, it was voted that the committee be discharged.

Mr. Gill reported progress on publications of the Academy.

On behalf of the committee on the organization of the national surveys and signal service, the chairman, Mr. Meigs, stated that the report of the committee had been presented to Congress, and printed. The committee was discharged.

The president appointed Mr. B. A. Gould to fill the vacancy in the committee on foreign associates, caused by the resignation of Mr. Agassiz. Mr. Wolcott Gibbs was appointed chairman of the committee.

At the request of the board of trustees of the Watson fund, Mr. Newcomb presented the following resolution, which was adopted by the Academy:

Resolved, That the Watson medal and the further sum of $100 in gold be awarded to Dr. Benjamin Apthorp Gould, for his valuable labors for nearly forty years in promoting the progress in astronomical science, and especially for his successful establishment of the national observatory of the Argentine Republic, as manifested in the six volumes of observations recently prepared and published by him.

By vote of the Academy, the trustees of the Watson fund were authorized to take the proper steps for having the medal struck.

Mr. Newcomb reported, on behalf of the trustees of the Watson fund, that while appropriations of money had been made for carrying out that part of Professor Watson's will, which provided for the making of tables of the asteroids, work had been only partially commenced, owing to the difficulty of finding a sufficiently skilled computer to make such computations. They had been obliged to send abroad to find a person to make the computations necessary to enable an unskilled computer to continue the work on the other planets.

THE HENRY DRAPER MEDAL.

At a public session of the Academy, held on the evening of April 21, the first Henry Draper medal awarded by the Academy was presented to Prof. S. P. Langley, by the president, who in a short address gave a résumé of Professor Langley's work in astronomical physics, and the reasons why the Academy had honored him with this medal.

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DEED OF TRUST OF MRS. HENRY DRAPER.

Know all men by these presents that I, Mary Anna Palmer Draper, of the city, county, and State of New York, in consideration of the premises, and of the acceptance of the within trust by the National Academy of Sciences, and also in consideration of divers other good and valuable considerations, I, the said Mary Anna Palmer Draper, hereto moving, have given, granted, assigned, transferred, and set over, and by these presents do give, grant, assign, transfer, and set over unto the said National Academy of Sciences, and to their successors forever, a certain fund or sum of $6,000, with the interest and income thereof, to have and to hold the same in trust, nevertheless upon the special trusts, and for the uses and purposes following, to wit:

First. In trust to invest, and to reinvest, the said sum of $6,000, and to keep the same invested in good and safe securities, or in such other manner as shall be, in their opinion, best for the preservation and maintenance of said fund.

Second. In trust to use the interest and income thereof for the purpose of striking a gold medal, which shall be called the "Henry Draper Medal," shall be of the value of $200, and shall be struck in a die to be selected and presented to said National Academy of Sciences, by me, the said Mary Anna Palmer Draper. And the said medal shall be awarded and presented from time to time by the said National Academy of Sciences to any person in the United States of America or elsewhere, who shall make an original investigation in astronomical physics, the results of which shall be made known to the public, such results being, in the opinion of the said National Academy of Sciences, of sufficient importance and benefit to science to merit such recognition; provided, however, that said medal shall not be presented or awarded more frequently than once in two years, and provided, also, that the investigation for which it is awarded, or the completed publication thereof, shall have been made since the time of the last preceding award and presentation of said medal.

Third. In trust that if discoveries of equal importance shall be made in astronomical physics at or about the same time in the United States of America, and also in some other part of the world, each of which discoveries might, in the opinion of the said Academy, entitle the discoverer to be considered as a competitor for said medal, preference shall be given in the awarding thereof to discoveries made by a citizen of the said United States of America.

Fourth. In trust that if the said die shall at any time be lost, destroyed, broken, or in any way rendered unfit for the purpose of striking the said medal, a new die shall be procured, exactly similar to the one selected and presented as aforesaid, and shall be paid for out of the interest and income of the said fund; and such sum or sums of money as shall at any time or times be necessary for the proper care, custody, and protection of the said die or of the said fund hereby given, shall also be taken from and out of the interest and income of the said fund, whenever the same shall be deemed necessary by the said National Academy of Sciences.

Fifth. In trust that if at any time or times the interest and income of the said trust fund of $6,000 shall exceed the amount necessary for the striking of said medal and the care of the said die, and of the fund, such surplus over and above the sum or sums so required for the purposes of the trust as hereinbefore recited and set forth, shall be used in such manner as shall be selected by said National Academy of Sciences, in aid of investigations and work in astronomical physics to be made and carried on by a citizen or citizens of the United States of America.

And the said National Academy of Sciences doth signify its acceptance of the said fund of $6,000, and doth engage to hold and manage the same upon the trusts and for the uses and purposes herein mentioned and set forth.

In witness whereof, I, the said Mary Anna Palmer Draper, have hereunto set my hand and seal, and the said National Academy of Sciences hath hereunto caused its

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corporate seal to be subscribed by its president, this thirteenth day of April, in the year one thousand eight hundred and eighty-three.

MARY ANNA PALMER DRAPER. [SEAL.]

Sealed and delivered in the presence of—
EDWARD A. DIXON,
MORNAY WILLIAMS,
As to Mary Anna Palmer Draper.

O. C. MARSH,
President of the National Academy of Sciences.

Witnesses to the signature of O. C. Marsh:
J. H. C. COFFIN.
ASAPH HALL.
SAM'L H. WALKER.

Executed and acknowledged before Mornay Williams, notary public, New York County.

Acknowledgment of officer of the Academy before Samuel H. Walker, notary public, District of Columbia.

REPORT OF COMMITTEE ON THE HENRY DRAPER MEDAL.

To the National Academy of Sciences:

By a resolution of the Academy, adopted April 19, 1883, it is made the duty of the committee on the Henry Draper medal "to recommend to the Academy from time to time such persons as they may consider deserving of the medal, with the ground of their recommendation."

The original deed of trust provides that "the said medal shall be awarded from time to time by the said National Academy of Sciences to any person in the United States of America or elsewhere, who shall make an original investigation in astronomical physics, the results of which shall be made known to the public, such results being, in the opinion of the said National Academy of Sciences, of sufficient importance and benefit to science to merit such recognition."

In accordance with the above resolution of the Academy, and with the provisions of the deed of trust, the committee on the Henry Draper medal begs leave to report that it has taken into consideration the researches which have recently been made by the men of science of this and other countries in the department of astronomical physics and that in consequence of such examination, the committee unanimously recommends that the Academy award the Henry Draper gold medal to Prof. Samuel P. Langley, of Allegheny, Pa. The committee bases this recommendation upon the numerous investigations of a high order of merit which have been made by Professor Langley within the past few years in solar physics, and especially in the domain of radiant energy. In corroboration of its opinion, the committee desires to specify the following memoirs, in which the results of these investigations are, for the most part, embodied:

1. *On the Minute Structure of the Solar Photosphere.* (Am. J. Sci., III, vii, 87, February, 1874.)

This paper gives the result of two years' work, and announces the discovery (since confirmed by Janssen) that four-fifths of the sun's light comes from less than one-fifth of its surface. It was illustrated with a plate containing the most detailed representation of a sun-spot, which had appeared up to that time.

2. *The External Aspects of the Sun.* (J. Frank. Inst., August and September, 1874.)

In this paper, the noted engraving of the "typical sun-spot" appeared for the first time. It was executed for the purpose of giving material for passing judgment on

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the current theories of sun-spots, and had undoubtedly a considerable influence in determining the present conviction of students of solar physics that the surface of the sun is essentially gaseous or cloudlike. This engraving has been reproduced by Secchi, Proctor, Young, and nearly every author who has written on the subject.

3. *On the Comparison of Certain Theories of Solar Structure with Observation.* (Am. J. Sci., III, ix, 192, March, 1875. Published simultaneously in Memoire degli Spettroscopisti Italiani, Vol. IV.)

A statement of the above consequences more in detail.

4. *Sur la température relative des diverses régions du soleil.* Première Partie. Les noyaux noirs des taches; Deuxième Partie. Région équatoriale et régions polaires. (Comptes Rendus, March 22 and 29, 1875.)

5. *Étude des radiations superficielles du soleil.* (Comptes Rendus, September 8, 1875.)

The author shows in these papers the existence of a remarkable thermochroic action in the solar atmosphere, such that the vibrations of great wave-length are less absorbed than the visible and ultra-violet. He proves also that no such difference between the polar and equatorial radiation as had been asserted by Secchi, exists. Hence, it follows that the sun, if deprived of his atmosphere, would appear *blue*. This statement, however, was first made in explicit terms at the Detroit meeting of the American Association for the Advancement of Science.

See the paper entitled—

6. *The Solar Atmosphere.* (Am. J. Sci., III, x, 490, December, 1875. Suppl. No.)

7. *Measurement of the direct effect of Sun-spots on Terrestrial Climates.* (Monthly Not. Royal Astr. Soc., November, 1876.)

Here the author essays a new method of determining whether sun-spots affect terrestrial climates or not, although he does not undertake to say whether they may not be the indices of some other action which does affect them. Considering the spots merely as interruptions of a determinate quantity of the solar heat, he succeeds in demonstrating that their total effect (from this point of view) on terrestrial climates cannot alter the mean temperature of the earth by so much as one degree Fahrenheit.

8. *On certain Remarkable Groups in the Lower Spectrum.* (Proc. Am. Acad., 1878.)

Contains the author's discovery of the duplicity of the rays in the "great A" group of the solar spectrum.

9. *On the Temperature of the Sun.* (Proc. Am. Acad., 1878.)

In this paper, the author publishes the results of his comparison of the heat and light of the sun with that of the molten steel in the Bessemer converter. At this time (so late as 1878), the temperature of the sun was maintained by physicists of high repute to be not over 1,500° C. The author's object in this comparison was not to determine this temperature, but to furnish irrefragable proof that it was at any rate very much higher than that which physicists, misled by Dulong and Petit's law, had assigned to it. Incidentally, the conclusion was reached that this celebrated law itself is absolutely unreliable, a position which is now fully conceded.

10. *Observations on Mount Etna.* (Am. J. Sci., III, xx, 33, July, 1880.)

The author here gives the results of his studies made during the winter of 1878–'79, upon the upper slopes of Mount Etna, which were connected with the improvement of solar observation by the employment of a station at a high altitude.

11. *The Progress of Solar Physics.*

An address as president of the physical section of the American Association for the Advancement of Science, delivered at Saratoga in August, 1879. (Proc. Am. Assoc., xxviii, 51, 1879.)

12. *The Bolometer and Radiant Energy.* (Proc. Am. Acad., xvi, 1880.)

13. *The Bolometer.* (Proc. Am. Metrol. Soc., December, 1880.)

14. *The Actinic Balance.* (Am. J. Sci., III, xxi, 187, March, 1881.)

His solar studies having convinced him that two-thirds of the sun's radiant energy was unexplored for want of the proper apparatus, the author spent the year 1880 in

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experiments on the construction of an instrument for analyzing and measuring this and like forms of energy. This instrument, which he called the bolometer, from *Βολη* and *μετρον*, is described in the papers above mentioned.

15. *Sur la distribution de l'energie dans le spectre solaire normal.* (Comptes Rendus, March 21, 1881.)
16. *Distribution de l'energie dans le spectre normal.* (Comptes Rendus, July 18, 1881.)
17. *La distribution de l'energie dans le spectre normal.* (Ann. Chim. Phys., February, 1882.)

The first fruit of the use of this new instrument was the demonstration that the amount of heat which the earth receives from the sun (the solar constant) had been greatly underestimated, owing, among other causes, to inability previously to measure the solar heat in sufficien'ly small portions of the spectrum. The leading facts in regard to the distribution of energy in the normal spectrum, from the sun, and the distribution of this solar energy before absorption by the earth's atmosphere, are given in these papers.

18. *The Selective Absorption of Solar Energy.* (Am. J. Sci., III, xxv, 169, March, 1883. Also, Ann. Phys. Chem., xix, 1883, and Ann. Chim. Phys., V, xxix, 497, August, 1883.)

Treated more fully in "The Professional Papers of the Signal Service. No. XV. Researches on Solar Heat and its Absorption by the Earth's Atmosphere. Expedition to Mount Whitney, 1884."

The results already announced were so important in their bearing on the science of terrestrial meteorology that the author conducted, under the joint auspices of the Allegheny Observatory and the United States Signal Service, an expedition to the Sierra Nevadas of Southern California, the results of which were published extensively in American and foreign scientific journals. In the first article above mentioned is an account of the leading facts observed; which are that the sun's light is essentially *blue*, and that what we call "white" light is due to the absorption of these blue rays, first by the sun's atmosphere and then by our own. It had always been supposed that the sun's red and infra-red rays were powerfully absorbed by our own atmosphere, which acted, according to the familiar comparison of Poisson and Pouillet, like the glass cover of a hot-bed, which absorbs solar heat more and more as we approach the infra-red. This universally accepted belief was directly contradicted by these researches, and it was shown that the nature as well as the amount of the absorption of the solar rays had been so wholly misunderstood that the general outlines of these important truths were here given for the first time. The value of the solar constant, which until now had been accepted, was radically altered, Pouillet's value, 1.7 calories, being raised to 3. In connection with this, a map was given of the infra-red solar spectrum, containing numerous lines and bands hitherto unknown; and, what was wholly new, with their places fixed upon the normal or wave-length scale by direct observation.

19. *Memoir on the Experimental Determination of Wave-lengths in the Invisible Prismatic Spectrum.* (Mem. Nat. Acad. Sci., 1884 (Read October, 1883). Also, Am. J. Sci., III, xxvii, 169, March, 1884, and Ann. Phys. Chem., July, 1884.)

Almost, if not absolutely, all of our present knowledge of the constitution of bodies forming the external universe is dependent upon our information concerning the wave-lengths of the energy they send us, of which that coming in the form of light and which is visible is but the smaller portion. Inasmuch as until lately, we have known almost nothing about any waves but visible ones, all our knowledge about terrestrial and other dark-heat radiation is in a condition of empiricism even to-day; a fact which is a great reproach to physical science. This arises chiefly from our want of knowledge in the past of any means of determining what these wave-lengths are, or, as a consequence of this, from our inability to analyze the invisible spectrum (in which two-thirds of the solar energy resides) in the way we can analyze the visible.

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The memoir above mentioned fixes the wave-lengths of solar heat, which had been known hitherto in the visible spectrum only, throughout its whole extent, and for the first time gives a trustworthy means of investigating that unknown major portion of the whole solar energy on which all organic life depends. This is the real purport of the somewhat abstruse, and, at first sight, unattractive investigations upon wave-lengths to which the author has devoted many years. He compares himself in this respect to one who is opening a path into hitherto unexplored country; not undertaking himself to study its natural history, but trying to execute the less attractive but indispensable labor of making the road on which future investigators may travel.

20. *On the Amount of the Atmospheric Absorption.* (Am. J. Sci., III, xxviii, 163, September, 1884.)

In this paper, it is shown, both from theoretical considerations and by experiment, that the absorption of the solar rays by the earth's atmosphere is at least double what it has commonly been supposed to be.

21. *On the Temperature of the Surface of the Moon.* (Mem. Nat. Acad. Sci., III, September, 1884.)

In this memoir, it is stated that it has been found possible to form a heat spectrum from the moon, and to analyze its different parts. The conclusion reached (which differs from that of Lord Rosse) is that the temperature of the sunlit surface of the moon cannot be greatly above zero centigrade. Results of interest in connection with solar radiation are also given.

Professor Langley has published numerous other papers upon subjects connected with solar or astral physics, but it is believed that those which have now been mentioned will fully justify the recommendation of the committee.

GEORGE F. BARKER,
Chairman.
WOLCOTT GIBBS.
SIMON NEWCOMB.
ARTHUR W. WRIGHT.
CHARLES A. YOUNG.

WASHINGTON, *April* 24, 1885.

NOMINATIONS.

It was voted by the Academy to postpone the election of new members for the present session.

Nine nominations for membership were made.

INVITATIONS.

It was announced that members of the Academy were invited to attend a meeting of the Anthropological Society, to be held on the evening of April 20.

The Academy adjourned April 23, 1885.

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SCIENTIFIC SESSION.

HELD IN BOSTON, MASS., NOVEMBER 9 TO 11, 1886.

A scientific session, for the reading of papers only, having been called by the council, as announced at the April session, the Academy met in the rooms of the Massachusetts Institute of Technology, Boston, Mass., on November 9, 1886.

The president, Prof. O. C. Marsh, presided.

The following members were present during the session:

Abbe.	Gould.	Langley.	Powell.
Abbot.	Gray.	Lovering.	Pumpelly.
Baird.	Hague.	Marsh.	Putnam.
Barker.	Hall, A.	Morse.	Rowland.
Billings.	Hall, J.	Newcomb.	Scudder.
Chandler.	Hill, G. W.	Newton, H. A.	Trowbridge, J.
Cope.	Hill, H. B.	Packard.	Walker.
Farlow.	Hunt.	Peters.	Young.
Gibbs, W.	Hyatt.	Pickering.	

The following gentlemen were invited to attend the meetings, and take part in the scientific proceedings: Sir Lyon Playfair, Mr. Alfred Russell Wallace, Mr. O. T. Sherman, Dr. W. L. Elkin, Prof. W. M. Davis, and the faculty of the Institute of Technology.

The following papers were read and discussed:

1. LANGLEY, S. P.—The Solar-Lunar Spectrum.
2. HUNT, T. STERRY.—A Basis of Chemistry.
3. HYATT, ALPHEUS.—Primitive Forms of Cephalopoda.
4. HYATT, ALPHEUS.—A Case of Evolution in the Migration of Forms.
5. HYATT, ALPHEUS.—Lituites of the Limestones of Phillipsburg, Canada.
6. PUTNAM, F. W.—Archæological Explorations in the Little Miami Valley, Ohio, conducted by F. W. Putnam and C. L. Metz.
7. PICKERING, E. C.—Draper Memorial Photographs.
8. COPE, E. D.—On the Lemurine Reversion in Human Dentition.
9. COPE, E. D.—On the Columella Auris of the Tailed Batrachia.
10. MORSE, EDWARD S.—Change in Mya since the Pliocene.
11. PACKARD, A. S.—The Cave Fauna of North America, with remarks on the Anatomy and Origin of Blind Forms.
12. PETERS, C. H. F.—A Chart of the Stars in the Group Præsepe.
13. PETERS, C. H. F.—A Catalogue of Stars from Positions in Various Astronomical Periodicals.
14. SHERMAN, O. T. (by invitation of the Academy).—A Catalogue of Bright Lines observed in the Atmosphere of β Lyræ.
15. ELKINS, W. L. (by invitation of the Academy).—On the Relative Motions of the Pleiades Group deduced from Measurements made with the Königsberg and Yale College Heliometers.
16. YOUNG, C. A.—Some Observations with Pritchard's Wedge Photometer. (Read by title.)
17. ABBE, C.—The Question of Barometer Exposure.

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18. HILL, G. W.—On the Construction of New Tables of Saturn.
19. PUMPELLY, R.—On the Relation of the Green Mountain Rocks to the Taconic.
20. HUNT, T. STERRY.—Hardness and Chemical Indifference in Solids.
21. WALLACE, ALFRED RUSSELL (by invitation of the Academy).—On Wind as a Seed-Carrier in Relation to one of the most Difficult Problems in Geographical Distribution.
22. DAVIS, WILLIAM M. (by invitation of the Academy).—The Mechanical Origin of the Triassic Monoclinical in the Connecticut Valley.

The scientific session closed November 11, 1886.

SPECIAL SESSION.

HELD IN BOSTON, MASS., NOVEMBER 10, 1886.

A special session of the Academy having been called by the council, in accordance with Article III, section 1, of the constitution, the Academy convened in the rooms of the Massachusetts Institute of Technology, November 10, 1886, the president, Prof. O. C. Marsh, presiding.

The president laid his annual report to Congress before the Academy, and gave an outline of the report, which is to include the proceedings of the present meeting. On motion, the report was adopted by the Academy.

The president then made a statement of the condition of the printing of the third volume of Memoirs, and urged upon members the necessity of having their Memoirs in a complete state for the printer, and especially that all drawings should be carefully made.

The resignation of Mr. Agassiz, who had withdrawn from the Academy on account of ill health, was accepted.

The name of Mr. Theodore Lyman was, at his request, transferred to the list of honorary members.

NOMINATIONS.

Three nominations for membership in the Academy were read by the secretary.

The committee on nomination of foreign associates also presented two names.

RESOLUTIONS.

The following resolutions were adopted:

Resolved, That the thanks of the National Academy of Sciences be tendered to the president and faculty of the Institute of Technology, for the use of apartments in the Institute building, and for the facilities and courtesies which they have extended to the Academy.

Resolved, That the thanks of the Academy be tendered to the Saint Botolph Club, for their most obliging invitation to make use of the facilities offered by the club.

Resolved, That the thanks of the Academy be tendered to the president and members of the Boston Society of Natural History, for their courteous invitation to visit the rooms of the society.

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The secretary made a statement concerning the printing of the Memoirs, and the annual dues of the members.

The special session was then adjourned.

Since the last meeting of the Academy, the president has received from the Académie des Sciences in Paris, a request to send a delegate from the National Academy of Sciences to an international conference to be held in Paris, April 16, 1887, to consider plans for making a chart of the heavens by photography.

In accordance with this request, Prof. C. H. F. Peters, of Hamilton College, has been appointed as the representative of the Academy at this important conference.

Respectfully submitted.

O. C. MARSH,
President of the National Academy of Sciences.

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APPENDICES.

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APPENDIX A.

AN ACT to incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That Louis Agassiz, Massachusetts; J. H. Alexander, Maryland; S. Alexander, New Jersey; A. D. Bache, at large; F. A. P. Barnard, at large; J. G. Barnard, United States Army, Massachusetts; W. H. C. Bartlett, United States Military Academy, Missouri; U. A. Boyden, Massachusetts; Alexis Caswell, Rhode Island; William Chauvenet, Missouri; J. H. C. Coffin, United States Naval Academy, Maine; J. A. Dahlgren, United States Navy, Pennsylvania; J. D. Dana, Connecticut; Charles H. Davis, United States Navy, Massachusetts; George Engelmann, Saint Louis, Mo.; J. F. Frazer, Pennsylvania; Wolcott Gibbs, New York; J. M. Gilliss, United States Navy, District of Columbia; A. A. Gould, Massachusetts; B. A. Gould, Massachusetts; Asa Gray, Massachusetts; A. Guyot, New Jersey; James Hall, New York; Joseph Henry, at large; J. E. Hilgard, at large, Illinois; Edward Hitchcock, Massachusetts; J. S. Hubbard, United States Naval Observatory, Connecticut; A. A. Humphreys, United States Army, Pennsylvania; J. L. LeConte, United States Army, Pennsylvania; J. Leidy, Pennsylvania; J. P. Lesley, Pennsylvania; M. F. Longstreth, Pennsylvania; D. H. Mahan, United States Military Academy, Virginia; J. S. Newberry, Ohio; H. A. Newton, Connecticut; Benjamin Peirce, Massachusetts; John Rodgers, United States Navy, Indiana; Fairman Rogers, Pennsylvania; R. E. Rogers, Pennsylvania; W. B. Rogers, Massachusetts; L. M. Rutherfurd, New York; Joseph Saxton, at large; Benjamin Silliman, Connecticut: Benjamin Silliman, junior, Connecticut; Theodore Strong, New Jersey; John Torrey, New York; J. G. Totten, United States Army, Connecticut; Joseph Winlock, United States Nautical Almanac, Kentucky; Jeffries Wyman, Massachusetts; J. D. Whitney, California, their associates and successors duly chosen, are hereby incorporated, constituted, and declared to be a body corporate, by the name of the National Academy of Sciences.

SEC. 2. *And be it further enacted*, That the National Academy of Sciences shall consist of not more than fifty ordinary members, and the said corporation hereby constituted shall have power to make its own organization, including its constitution, by-laws, and rules and regula-

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tions; to fill all vacancies created by death, resignation, or otherwise; to provide for the election of foreign and domestic members, the division into classes, and all other matters needful or usual in such institution, and to report the same to Congress.

SEC. 3. *And be it further enacted*, That the National Academy of Sciences shall hold an annual meeting at such place in the United States as may be designated, and the Academy shall, whenever called upon by any Department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any services to the Government of the United States.

Approved, March 3, 1863.

AN ACT to amend the act to incorporate the National Academy of Sciences.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act to incorporate the National Academy of Sciences, approved March three, eighteen hundred and sixty-three, be, and the same is hereby, so amended as to remove the limitation of the number of ordinary members of said Academy as provided in said act.

Approved, July 14, 1870.

DEPARTMENT OF STATE, *June* 10, 1882.

True copies.

SEVELLON A. BROWN,
Chief Clerk.

AN ACT to authorize the National Academy of Sciences to receive and hold trust funds for the promotion of science, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the National Academy of Sciences, incorporated by the act of Congress approved March third, eighteen hundred and sixty-three, and its several supplements, be, and the same is hereby, authorized and empowered to receive bequests and donations, and hold the same in trust, to be applied by the said Academy in aid of scientific investigations, and according to the will of the donors.

Approved, June 20, 1884.

DEPARTMENT OF STATE, *June* 24, 1884.

A true copy.

SEVELLON A. BROWN,
Chief Clerk.

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APPENDIX B.

CONSTITUTION AND RULES OF THE NATIONAL ACADEMY OF SCIENCES.

As amended and adopted April 17, 1872, and further amended April 20, 1875, April 21 1881, April 19, 1882, and April 18, 1883.

PREAMBLE.

Empowered by the act of incorporation enacted by Congress, and approved by the President of the United States, on the 3d day of March, A. D. 1863, and in conformity with the amendment to said act, approved July 14, 1870, the National Academy of Sciences adopts the following amended constitution and rules:

ARTICLE I.—OF MEMBERS.

SEC. 1. The Academy shall consist of members, honorary members, and foreign associates. Members must be citizens of the United States.

SEC. 2. Members who, from age or inability to attend the sessions of the Academy, wish to resign the duties of active membership, may, at their own request, be transferred to the roll of honorary members by a vote of the Academy.

SEC. 3. The Academy may elect fifty foreign associates.

SEC. 4. Honorary members and foreign associates shall have the privilege of attending the meetings, and of reading and communicating papers to the Academy, but shall take no part in its business, shall not be subject to its assessments, and shall be entitled to a copy of the publications of the Academy.

ARTICLE II.—OF THE OFFICERS.

SEC. 1. The officers of the Academy shall be a president, a vice-president, a foreign secretary, a home secretary, and a treasurer, all of whom shall be elected for a term of six years, by a majority of votes present at the first stated session after the expiration of the current terms, provided that existing officers retain their places until their successors are elected. In case of a vacancy, the election for six years shall be held in the same manner at the session when such vacancy occurs, or at the next stated session thereafter, as the Academy may direct. A vacancy in the office of treasurer or home secretary may, however, be filled by

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appointment of the president of the Academy until the next stated session of the Academy.

SEC. 2. The officers of the Academy, together with six members to be elected by the Academy at the first stated session in each year, shall constitute a council for the transaction of such business as may be assigned to them by the constitution or the Academy.

SEC. 3. The president of the Academy, or, in case of his absence or inability to act, the vice-president, shall preside at the meetings of the Academy and of the council; shall name all committees except such as are otherwise especially provided for; shall refer investigations required by the Government of the United States to members especially conversant with the subjects, and report thereon to the Academy at its session next ensuing; and, with the council, shall direct the general business of the Academy.

It shall be competent for the president, in special cases, to call in the aid, upon committees, of experts or men of special attainments, not members of the Academy.

SEC. 4. The foreign and home secretaries shall conduct the correspondence proper to their respective departments, advising with the president and council in cases of doubt, and reporting their action to the Academy at one of the stated sessions in each year.

It shall be the duty of the home secretary to give notice to the members, of the place and time of all meetings, of all nominations for membership, and of all proposed amendments to the constitution.

The minutes of each session shall be duly engrossed before the next stated session, under the direction of the home secretary.

SEC. 5. The treasurer shall attend to all receipts and disbursements of the Academy, giving such bond and furnishing such vouchers as the council may require. He shall collect all dues from members, and keep a set of books showing a full account of receipts and disbursements. He shall present a general report at the April session. He shall be the custodian of the corporate seal of the Academy.

ARTICLE III.—OF THE MEETINGS.

SEC. 1. The Academy shall hold one stated session in each year, in the city of Washington, on the third Tuesday in April, and another may be held at such place and time as the council shall determine.

Special sessions of the Academy may be called by order of eight members of the council, at such place and time as may be designated in the call.

Scientific sessions of the Academy may be held at times and places to be designated by a majority of the council.

SEC. 2. The names of the members present at each daily meeting shall be recorded in the minutes; and the members present at any meeting shall constitute a quorum for the transaction of business.

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SEC. 3. Scientific meetings of the Academy, unless otherwise ordered by a majority of the members present, shall be open to the public; those for the transaction of business, closed.

SEC. 4. The stated meetings of the council shall be held during the stated or special sessions of the Academy. Special meetings may be convened at the call of the president and two members of the council, or of four members of the council.

SEC. 5. No member who has not paid his dues shall take part in the business of the Academy.

ARTICLE IV.—OF ELECTIONS AND RESIGNATIONS.

SEC. 1. All elections shall be by ballot, and each election shall be held separately, unless otherwise ordered by this constitution.

SEC. 2. The time for holding an election for officers shall be fixed by the Academy at least one day before the election is held.

SEC. 3. The six additional members of the council shall be elected on any day after the first of the first stated session in each year, by each voter inscribing six names on his ballot, and those six who have received more votes than any others shall be declared elected. If two or more names have received the lowest number of votes that would elect, additional balloting shall be had for as many members as remain each time to be elected until the number is full.

The term of the members so elected shall commence at the close of the session at which they are elected, and continue until the close of the first stated session in the next year.

SEC. 4. Nominations of members may be made in writing, signed by any five members of the Academy, at any stated session, to be voted on at the next stated session held in Washington, and each nomination shall, at the time of election, be accompanied by a written list of the original works of the nominee.

SEC. 5. Elections for membership shall be held in the following manner: Each member may inscribe on a ballot not more than five names of nominees selected from the list. Absent members may send such ballots to the home secretary. From the seven names receiving the highest number of votes in this preference ballot, the members present may proceed to elect new members in the following manner: At each ballot, each member present may vote for not exceeding three persons, and the person receiving the highest number of votes shall be declared elected, provided that he received two-thirds of the votes cast, and that his name appear on not less than twenty ballots; and, provided further, that the number of members of the Academy be not already one hundred or over, in which case, to be declared to be elected, he must receive four-fifths of the votes cast, and his name must appear on at least twenty-five ballots.

Should several candidates have the same minimum number of votes on the preference list, the requisite number for completing the list shall be selected from them by a two-thirds vote of the members present.

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Election of members shall be held only at the regular stated session of each year held in Washington, and not more that five members shall be elected at that session.

Before, and during elections, a discussion of the merits of nominees will be in order.

The election of members may be suspended at any time by a majority vote of the members present.

SEC. 6. Every member elect shall accept his membership, personally or in writing, before the close of the next stated session after the date of his election. Otherwise, on proof that the secretary has formally notified him of his election, his name shall not be entered on the roll of members.

SEC. 7. Foreign associates may be nominated by a committee of five members to be appointed for that purpose by the president, and elected at any stated session by a two-thirds vote of the members present. The election shall be had by each member indicating on a ballot those names for which he votes, and those nominees whose names appear on two-thirds of the ballots shall be declared elected.

SEC. 8. A diploma, with the corporate seal of the Academy, and the signatures of the officers, shall be sent by the appropriate secretary to each member on his acceptance of his membership, and to foreign associates on their election.

SEC. 9. Resignations shall be addressed to the president, and acted on by the Academy.

ARTICLE V.—OF SCIENTIFIC COMMUNICATIONS, PUBLICATIONS, AND REPORTS.

SEC. 1. Communications on scientific subjects shall be read at scientific meetings of the Academy, and papers by any member may be read by the author, or by any other member, notice of the same having been previously given to the secretary.

SEC. 2. Any member of the Academy may read a paper from a person who is not a member, and shall not be considered responsible for the facts or opinions expressed by the author, but shall be held responsible for the propriety of the paper.

Persons who are not members may read papers on invitation of the president, with the advice of the council.

SEC. 3. The Academy may provide for the publication, under the direction of the council, of proceedings, memoirs, and reports.

SEC. 4. Propositions for investigations or reports by the Academy shall be submitted to the council for approval, except those requested by the Government of the United States, which shall be acted on by the president, who will in such cases report their results to the Government as soon as obtained, and to the Academy at its next following stated session.

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SEC. 5. The advice of the Academy shall be, at all times, at the disposition of the Government, upon any matter of science or art within its scope.

SEC. 6. An annual report to be presented to Congress shall be prepared by the president, and before its presentation, submitted by him, first to the council, and afterwards to the Academy, at one of the stated sessions.

SEC. 7. Medals and prizes may be established, and the means of bestowing them accepted by the Academy, upon the recommendation of the council, by whom all the necessary arrangements for their establishment and award shall be made.

Bequests and trusts having for their object the advancement of science may also be accepted and administered by the Academy.

ARTICLE VI.—OF THE PROPERTY OF THE ACADEMY.

SEC. 1. All investments shall be made by the treasurer, in the corporate name of the Academy, in stocks of the United States.

SEC. 2. No contract shall be binding upon the Academy which has not been first approved by the council.

SEC. 3. The assessments required for the support of the Academy shall be fixed by the Academy on the recommendation of the council.

ARTICLE VII.—OF ADDITIONS AND AMENDMENTS.

Additions and amendments to the constitution shall be made only at a stated session of the Academy. Notice of a proposition for such a change must be given at a stated session, and shall be referred to the council, which may amend the proposition, and shall report thereon to the Academy at the same session. Its report shall be considered by the Academy in committee of the whole for amendment.

The proposition as amended, if adopted in committee of the whole, shall be voted on at the next stated session, and if it receives two-thirds of the votes cast, it shall be declared adopted.

Absent members may send their votes on pending changes in the constitution to the home secretary in writing, and such votes shall be counted as if the member were present.

RULES.

I. In the absence of any officer, a member shall be chosen to perform his duties temporarily, by a plurality of *viva voce* votes, upon open nominations.

II. The accounts of the treasurer shall be referred to an auditing committee of three members, to be appointed by the president at the meeting at which the accounts are presented, which committee shall report before the close of that session, and shall then be discharged.

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The bonds, securities, and other property owned or held in trust by the Academy shall be inspected and verified by a committee to be annually appointed by the president. The report of this committee shall be presented to the Academy at its first stated session in each year, and referred with the accounts to the auditing committee.

III. A committee of arrangements consisting of five members shall be appointed by the president for each stated session of the Academy. This committee shall meet not less than two weeks previous to each session. It shall be in session during the meetings to make arrangements for the reception of the members; to arrange the business of each day; to receive the titles of papers, reports, &c.; and to arrange the order of reading, and, in general, to attend to all business and scientific arrangements.

IV. At the meetings, the order of business shall be as follows:

1. Chair taken by the president, or, in his absence, by the vice-president.
2. Roll of members called by home secretary.
3. Minutes of the preceding meeting read and approved.
4. Stated business.
5. Reports of president, secretaries, treasurer, and committees.
6. Business from council.
7. Other business.
8. On the last day of the session, the rough minutes of that day's proceedings are to be read for correction.

V. The rules of order of the Academy shall be those of the Senate of the United States, unless suspended by unanimous consent.

VI. Unless otherwise ordered by the Academy, the scientific meetings shall be convened at noon.

VII. The death of members shall be announced by the president on the last day of any session, when a member shall be selected by the president to furnish a biographical notice of the deceased at the next stated session. If such notice be not then furnished, another member may be selected by the president in place of the first, and so on until the duty is performed.

VIII. All discussions as to the claims and qualifications of nominees at meetings of the Academy will be held strictly confidential, and remarks and criticisms then made may be communicated to no person who was not a member of the Academy at the time of the discussion.

IX. The secretaries will receive memoirs at any time, and report the date of their reception at the next session. But no memoir shall be published unless it has been read before the Academy.

X. Memoirs shall date in the records of the Academy from the date of their presentation to the Academy, and the order of their presentation shall be that in which they were registered, unless changed by consent of the author.

XI. Papers from persons not members, read before the Academy, and intended for publication, shall be referred, at the meeting at which they

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are read, to a committee of members competent to judge whether the paper is worthy of publication. Such committee shall report to the Academy as early as practicable, and not later than the next stated session.

XII. An annual of the Academy shall be prepared and published by the secretaries.

XIII. The printing of the Academy shall be under the charge of a committee of publication, to consist of the home secretary, and four other members to be named by the president, with the advice and consent of the council.

XIV. The annual report of the Academy may be accompanied by a memorial to Congress in regard to such investigations and other subjects as may be deemed advisable, recommending appropriations therefor when necessary.

XV. The proper secretary shall acknowledge all donations made to the Academy, and shall report them at the next stated session.

XVI. The books, apparatus, archives, and other collections of the Academy shall be deposited in some safe place in the city of Washington. A list of the articles so deposited shall be kept by the home secretary, who is authorized to employ a clerk to take charge of them.

XVII. A stamp corresponding to the corporate seal of the Academy shall be kept by the secretaries, who shall be responsible for the due marking of all books and other objects to which it is applicable.

Labels, or other proper marks of similar device, shall be placed upon objects not admitting of the stamp.

XVIII. On the first day of each stated session, immediately after calling the roll of members, a recording secretary shall be elected by a plurality of members present, to assist the home secretary in keeping the records of the session.

XIX. It shall be the duty of the committee of arrangements to fix the length of time to be devoted to reading of all papers submitted, and to limit the time to be occupied in their discussion.

XX. Ballots for election of members may be sent by sealing them up in a blank envelope, and inclosing this in another, across the back of which is written the name of the sender, and which is addressed to the home secretary; such envelopes will be opened only by the tellers.

XXI. Any rule of the Academy may be amended, suspended, or repealed on the written motion of any two members, signed by them, and presented at a stated session of the Academy, provided the same shall be approved by a majority of the members present.

XXII. Nominations for membership should state the full name, residence, the official position, and the special scientific studies of the candidate. A form of nomination shall be prepared by the home secretary.

By a resolution adopted January 12, 1864, the president is, *ex officio*, a member of all Government committees of the Academy.

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APPENDIX C.

ORGANIZATION OF THE ACADEMY, 1886.

	Expiration of term.
MARSH, O. C., *President*	April, 1889.
NEWCOMB, S., *Vice-President*	April, 1889.
GIBBS, WOLCOTT, *Foreign Secretary*	April, 1892.
HALL, A., *Home Secretary*	April, 1889.
COFFIN, J. H. C., *Treasurer*	April, 1887.

ADDITIONAL MEMBERS OF COUNCIL, 1886–'87.

BAIRD, S. F.
BRUSH, G. J.
LANGLEY, S. P.
MEIGS, M. C.
PICKERING, E. C.
YOUNG, C. A.

COMMITTEES OF THE ACADEMY.

On Ways and Means to Provide a Fund for the Academy.

ROGERS, FAIRMAN, *Chairman.*
CHANDLER, C. F.
MARSH, O. C.
MITCHELL, S. WEIR.
PUMPELLY, R.

On Weights, Measures, and Coinage.

BARNARD, F. A. P., *Chairman.*
GIBBS, WOLCOTT.
HILGARD, J. E.
MEIGS, M. C.
NEWCOMB, S.
NEWTON, H. A.
PEIRCE, C. S.
TROWBRIDGE, W. P.

On the Election of Foreign Associates.

GIBBS, WOLCOTT, *Chairman.*
DANA, J. D.
GOULD, B. A.
HALL, A.
NEWCOMB, S.

On Reserving Public Lands on and near Mount Whitney, California, for Scientific Purposes.

LANGLEY, S. P., *Chairman.*
BREWER, W. H.
POWELL, J. W.

On Publication.

THE HOME SECRETARY.
BAIRD, S. F.
COFFIN, J. H. C.
NEWCOMB, S.
POWELL, J. W.

On Publications of the Academy.

GILL, T.

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On the Relation of the Academy to the Government.

THE PRESIDENT.
VICE-PRESIDENT.
SECRETARIES.
BAIRD, S. F.
COFFIN, J. H. C.
HILGARD, J. E.
MEIGS, M. C.
POWELL, J. W.

GOVERNMENT COMMITTEES.

On the Astronomical Day, Eclipse of 1886, and New Observatory.

BARNARD, F. A. P., *Chairman.*
BELL, A. GRAHAM.
DANA, J. D.
LANGLEY, S. P.
LYMAN, THEODORE.
PICKERING, E. C.
YOUNG, C. A.

On the Tariff Classification of Wool.

CHANDLER, C. F., *Chairman.*
BREWER, W. H.
MORTON, H.

On Opium.

REMSEN, IRA, *Chairman.*
BARKER, GEO. F.

TRUST FUNDS.

Board of Direction of the Bache Fund.

DANA, J. D.
HILGARD, J. E.
GIBBS, W.

Board of Trustees of the Watson Fund.

HILGARD, J. E.
NEWCOMB, S.
COFFIN, J. H. C.

On the Henry Draper Medal.

BARKER, G. F., *Chairman.*
GIBBS, W.
NEWCOMB, S.
WRIGHT, A. W.
YOUNG, C. A.

On the J. Lawrence Smith Medal.

GIBBS, WOLCOTT, *Chairman.*
BRUSH, G. J.
HALL, A.
PUMPELLY, R.
RUTHERFURD, L. M.

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MEMBERS OF THE NATIONAL ACADEMY OF SCIENCES, JANUARY, 1887.

		Date of election.
ABBE, CLEVELAND	*Washington, D. C.*	1879
ABBOT, HENRY L., U. S. A	*Whitestone, Long Island, N. Y.*	1872
ALLEN, J. ASAPH	*American Museum, New York City.*	1876
BAIRD, SPENCER F	*Washington, D. C.*	1864
BARKER, GEORGE F	3909 *Locust St., Philadelphia, Pa.*	1876
BARNARD, FREDERICK A. P	*New York City.*	——
BARTLETT, WILLIAM H. C	75 *Locust Hill Ave., Yonkers, N. Y.*	——
BELL, A. GRAHAM	*Washington, D. C.*	1883
BILLINGS, JOHN S., U. S. A	*Washington, D. C.*	1883
BREWER, WILLIAM H	*New Haven, Conn.*	1880
BROOKS, W. K	*Johns Hopkins University, Baltimore, Md.*	1884
BROWN-SEQUARD, CHARLES E	*Paris, France.*	1868
BRUSH, GEORGE J	*New Haven, Conn.*	1868
CHANDLER, CHARLES F	*New York City.*	1874
COFFIN, JOHN H. C., U. S. N	*Washington, D. C.*	——
COMSTOCK, CYRUS B., U. S. A	*Army Building, New York City.*	1884
COOKE, JOSIAH P	*Cambridge, Mass.*	1872
COPE, EDWARD D	2100 *Pine St., Philadelphia, Pa.*	1872
COUES, ELLIOTT	*Washington, D. C.*	1877
CRAFTS, JAMES M	*Ecole des Mines, Paris, France.*	1872
DALTON, J. C	43 *W. Forty-eighth St., New York City.*	1864
DANA, EDWARD S	*New Haven, Conn.*	1864
DANA, JAMES D	*New Haven, Conn.*	——
DAVIDSON, GEORGE	*San Francisco, Cal.*	1874
DUTTON, CLARENCE E., U. S. A	*Washington, D. C.*	1884
EADS, JAMES B	*Saint Louis, Mo.*	1872
FARLOW, W. G	*Cambridge, Mass.*	1879
FERREL, WILLIAM	*Washington, D. C.*	1868
GENTH, FREDERICK A	*West Philadelphia, Pa.*	1872
GIBBS, JOSIAH WILLARD	*New Haven, Conn.*	1879
GIBBS, WOLCOTT	*Cambridge, Mass.*	——
GILBERT, GROVE K	*Washington, D. C.*	1883
GILL, THEODORE N	*Washington, D. C.*	1873
GOULD, BENJAMIN A	*Cambridge, Mass.*	——
HAGUE, ARNOLD	*U. S. Geological Survey, Washington, D. C.*	1885
HALL, ASAPH, U. S. N	*Washington, D. C.*	1875
HALL, JAMES	*Albany, N. Y.*	——
HAYDEN, F. V	1803 *Arch St., Philadelphia, Pa.*	1873
HILGARD, EUGENE W	*Oakland, Cal.*	1872
HILGARD, JULIUS E	*Washington, D. C.*	——
HILL, GEORGE W	*Washington, D. C.*	1874
HILL, HENRY B	*Cambridge, Mass.*	1883
HOLDEN, EDWARD S	*Berkeley, Cal.*	1885
HUNT, T. STERRY	*Montreal, Canada.*	1873

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		Date of election.
HYATT, ALPHEUS	*Soc. of Nat. History, Boston, Mass.*	1875
JACKSON, CHARLES L	*Cambridge, Mass.*	1883
JOHNSON, SAMUEL W	*New Haven, Conn.*	1866
KING, CLARENCE	62 *Cedar St., New York.*	1876
LANGLEY, SAMUEL P	*Observatory, Allegheny, Pa.*	1876
LEIDY, JOSEPH	*Philadelphia, Pa.*	1884
LESLEY, J. PETER	1008 *Clinton St., Philadelphia, Pa.*	——
LECONTE, JOHN	*Berkeley, Cal.*	1878
LECONTE, JOSEPH	*Berkeley, Cal.*	1875
LESQUEREUX, LEO	302 *Fourth St., Columbus, Ohio.*	1864
LOOMIS, ELIAS	*New Haven, Conn.*	1873
LOVERING, JOSEPH	*Cambridge, Mass.*	1873
MARSH, O. C	*New Haven, Conn.*	1874
MAYER, ALFRED M	*Hoboken, N. J.*	1872
MEIGS, MONTGOMERY C., U. S. A	*Washington, D. C.*	1865
MITCHELL, HENRY	*U. S. Coast Survey, Boston, Mass.*	1885
MITCHELL, S. WEIR	1332 *Walnut St., Philadelphia, Pa.*	1865
MORSE, EDWARD S	*Salem, Mass.*	1876
MORTON, HENRY	*Hoboken, N. J.*	1874
NEWBERRY, J. S	*New York City.*	——
NEWCOMB, SIMON, U. S. N	*Washington, D. C.*	1869
NEWTON, H. A	*New Haven, Conn.*	——
NEWTON, JOHN, U. S. A	*Washington, D. C.*	1876
OLIVER, JAMES E	*Ithaca, N. Y.*	1872
PACKARD, A. S	*Providence, R. I.*	1872
PEIRCE, CHARLES S	*U. S. Coast Survey, Washington, D. C.*	1877
PETERS, C. H. F	*Clinton, N. Y.*	1876
PICKERING, EDWARD C	*Cambridge, Mass.*	1873
POWELL, JOHN W	*Washington, D. C.*	1880
PUMPELLY, RAPHAEL	*Gibbs Ave., Newport, R. I.*	1872
PUTNAM, FREDERICK W	*Cambridge, Mass.*	1885
REMSEN, IRA	*Johns Hopkins University, Baltimore, Md.*	1882
ROGERS, FAIRMAN	202 *W. Rittenhouse Sq., Philadelphia, Pa.*	——
ROGERS, WILLIAM A	*Cambridge, Mass.*	1885
ROOD, OGDEN N	*New York City.*	1865
ROWLAND, HENRY A	*Johns Hopkins University, Baltimore, Md.*	1881
RUTHERFURD, LEWIS M	175 *Second Avenue, New York City.*	——
SCHOTT, CHARLES A	*Washington, D. C.*	1872
SCUDDER, SAMUEL H	*Cambridge, Mass.*	1877
SELLERS, WILLIAM	1600 *Hamilton St., Philadelphia, Pa.*	1873
SMITH, SIDNEY I	*New Haven, Conn.*	1884
TROWBRIDGE, JOHN	*Cambridge, Mass.*	1878
TROWBRIDGE, WILLIAM P	*New York City.*	1872
TRUMBULL, J. H	*Hartford, Conn.*	1872
VERRILL, A. E	*New Haven, Conn.*	1872
WALKER, FRANCIS A	*Boston, Mass.*	1878
WOOD, HORATIO C	1925 *Chestnut St., Philadelphia, Pa.*	1879
WORTHEN, A. H	*Springfield, Ill.*	1872
WRIGHT, ARTHUR W	*New Haven, Conn.*	1881
YOUNG, CHARLES A	*Princeton, N. J.*	1872

HONORARY MEMBERS.

GRAY, ASA	*Cambridge, Mass.*
LONGSTRETH, MEIRS F	*Derby, Pa.*
LYMAN, THEODORE	*Brookline, Mass.*

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DECEASED MEMBERS.

	Date of death.
*AGASSIZ, LOUIS	Dec. 14, 1873
*ALEXANDER, J. H	Mar. 2, 1867
*ALEXANDER, STEPHEN	June 25, 1883
*BACHE, ALEXANDER DALLAS	Feb. 14, 1867
BARNARD, J. G	May 14, 1882
*CASWELL, ALEXIS	Jan. 8, 1877
*CHAUVENET, WILLIAM	Dec. 13, 1870
*CLARK, HENRY JAMES	July 1, 1873
*COFFIN, JAMES H	Jan. 6, 1873
DAVIS, CHARLES H	Feb. 18, 1877
DRAPER, HENRY	Nov. 20, 1882
*DRAPER, JOHN W	Jan. 4, 1882
ENGELMANN, GEORGE	Feb. 11, 1884
*FRAZIER, JOHN FRIES	Oct. 14, 1872
*GABB, WILLIAM M	May 30, 1878
*GILLISS, JAMES MELVILLE	Feb. 9, 1865
*GOULD, AUGUSTUS A	Sept. 15, 1866
*GUYOT, ARNOLD	Feb. 8, 1884
*HENRY, JOSEPH	May 13, 1878
*HADLEY, JAMES	Aug. 1, 1864
*HITCHCOCK, EDWARD	Feb. 27, 1864
*HOLBROOK, J. E	Sept. 8, 1871
*HUBBARD, J. S	Aug. 16, 1863
*HUMPHREYS, A. A	Nov. 28, 1883
*HALDEMAN, S. S	Sept. 10, 1880
*KIRTLAND, JARED P	Dec. 10, 1877
*LANE, J. HOMER	—— —, 1880
*LECONTE, JOHN L	Nov. 15, 1883
*MAHAN, D. H	Sept. 16, 1871
MARSH, G. P	July 23, 1882
*MEEK, F. B	Dec. 21, 1877
*MORGAN, LEWIS H	Dec. 14, 1881
*NORTON, WILLIAM A	Sept. 21, 1883
*POURTALES, L. F	July 17, 1880
RODGERS, JOHN	May 5, 1882
ROGERS, ROBERT E	Sept. 7, 1884
ROGERS, WILLIAM B	May 30, 1882
*SAXTON, JOSEPH	Oct. 26, 1873
*SILLIMAN, BENJ., Sr	Nov. 24, 1864
SILLIMAN, BENJ., Jr	Jan. 14, 1885
*SMITH, J. LAWRENCE	Oct. 12, 1883
*STIMPSON, WILLIAM	May 26, 1873
*STRONG, THEODORE	Feb. 1, 1869
*SULLIVANT, W. S	Apr. 30, 1873
*TORREY, JOHN	Mar. 10, 1873
*TOTTEN, J. G	Apr. 22, 1864
TUCKERMAN, EDWARD	Mar. 15, 1886
*WARREN, G. K	Aug. 8, 1882
WATSON, JAMES C	Nov. 23, 1880
*WINLOCK, JOSEPH	Jan. 11, 1875
*WOODWARD, J. J., U. S. A	Aug. 17, 1884
*WYMAN, JEFFRIES	Sept. 4, 1874

* Biographical notices have been presented of those designated by a *.

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FOREIGN ASSOCIATES.

BUNSEN, ROBERT W.....*Heidelberg.*
AIRY, SIR GEORGE B.....*Greenwich.*
OWEN, RICHARD.....*London.*
BURMEISTER, C. H. C.....*Buenos Ayres.*
STRUVE, OTTO VON.....*Pulkova.*
ADAMS, J. C.....*Cambridge.*
CAYLEY, ARTHUR.....*Cambridge.*
CLAUSIUS, RUDOLPH.....*Bonn.*
HELMHOLTZ, BARON H. VON.....*Berlin.*
KIRCHOFF, G. R.....*Berlin.*
PASTEUR, LOUIS.....*Paris.*
STOKES, G. G.....*Cambridge.*
SYLVESTER, J. J.....*Oxford.*
HOOKER, SIR J. D.....*Kew.*
THOMSON, SIR WILLIAM.....*Glasgow.*
AUWERS, ARTHUR.....*Berlin.*
BERTRAND, J. L. F.....*Paris.*
HUXLEY, T. H.....*London.*
VIRCHOW, RUDOLPH VON.....*Berlin.*
BERTHELOT, M. P. E.....*Paris.*
BOUSSINGAULT, J. B. J. D.....*Paris.*
CHEVREUL, M. E.....*Paris.*
DE CANDOLLE, ALPHONSE.....*Geneva.*
KÖLLIKER, ALBERT VON.....*Würzburg.*
OPPOLZER, THEODORE VON.....*Vienna.*
RICHTHOFEN, F. VON.....*Berlin.*

DECEASED FOREIGN ASSOCIATES.

SIR WM. ROWAN HAMILTON.
KARL ERNST VON BAER.
HENRY MILNE-EDWARDS.
MICHAEL FARADAY.
L. ELIE DE BEAUMONT.
SIR DAVID BREWSTER.
G. A. A. PLANA.
F. W. A. ARGELANDER.
FRIEDRICH WÖHLER.
J. B. DUMAS.
MICHEL CHASLES.
SIR RODERICK I. MURCHISON.
VICTOR REGNAULT.
H. W. DOVE.
C. A. F. PETERS.
JUSTUS VON LIEBIG.
ALEXANDER BRAUN.
JOACHIM BARRANDE.
ADOLPHE WÜRTZ.

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APPENDIX D.

REPORT ON OPIUM.

[CORRESPONDENCE.]

YALE COLLEGE,
New Haven, Conn., June 18, 1886.

SIR: I have the honor to transmit to you herewith a report on opium, made by a committee of the National Academy of Sciences, in compliance with the request contained in your communication dated April 7, 1886.

I will return by a later mail the remaining portion of the sample of opium analyzed.

Very respectfully,

O. C. MARSH,
President of the National Academy of Sciences.

Hon. C. S. FAIRCHILD,
Acting Secretary of the Treasury.

TREASURY DEPARTMENT,
Washington, D. C., April 7, 1886.

Prof. O. C. MARSH,
President of the National Academy of Sciences:

SIR: I transmit herewith a sample taken from a lot of prepared opium, seized by the collector of customs at Portland, Oregon, on the supposition that it had been smuggled.

With a view to determining the precise character of this article, it is deemed to be of importance that it should be analyzed with a view to ascertaining what percentage of morphia it contains.

I will thank you to cause such analysis to be made, under the direction of the National Academy of Sciences, and to inform me of the result thereof at your early convenience.

Return of such portion of the sample as is not consumed in the analysis is also requested.

Respectfully, yours,

C. S. FAIRCHILD,
Acting Secretary.

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YALE COLLEGE,
New Haven, Conn., April 26, 1886.

Hon. C. S. FAIRCHILD,
Acting Secretary of the Treasury:

SIR: I have the honor to acknowledge the receipt of your communication of the 7th instant, requesting an investigation, under the direction of the National Academy of Sciences, of a sample of prepared opium, which, also, after some delay, reached me through the Smithsonian Institution.

I have placed the matter in the hands of a special committee of the Academy, consisting of Prof. Ira Remsen, Johns Hopkins University, Baltimore, Md., *chairman*, and Prof. George F. Barker, University of Pennsylvania, Philadelphia.

These gentlemen will give the subject careful consideration, and report at an early day.

Very respectfully,

O. C. MARSH,
President of the National Academy of Sciences.

REPORT.

Prof. O. C. MARSH,
President of the National Academy of Sciences:

SIR: The committee of the Academy appointed by you, at the request of the Acting Secretary of the Treasury, to examine a specimen of opium seized by the collector of customs at Portland, Oregon, herewith submit their report:

The specimen has the appearance of a thick syrup. Analyses showed that it contains: Water, 22.76 per cent., and morphine, 19.53 per cent.

After drying, the powder left behind contains: Morphine, 25.28 per cent.

The morphine was determined by Flückiger's process, as modified by Dr. E. R. Squibb. (See Ephemeris, Vol. I, p. 14.)

It is well known that results obtained by different methods differ between comparatively wide limits. The committee proposed to investigate the principal methods with the view of determining, as far as possible, which of them gives the most reliable results. On communication with the Acting Secretary of the Treasury on the subject, the committee was informed that all that was desired was information regarding the percentage of morphine contained in the specimen of opium. Under the circumstances, the committee did not feel justified in extending the scope of the work beyond the mere making of the analysis, the results of which were given above.

IRA REMSEN,
Chairman.
GEORGE F. BARKER.

BALTIMORE, *June* 14, 1886.

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National Academy of Sciences, Washington, D.C.
Report.

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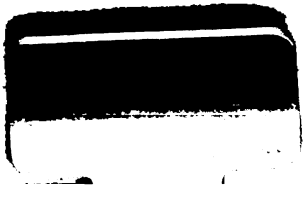

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